Specific Absorption Rate (SAR) Test Report
for
Glenayre Electronics Inc.
on the
AccessLink II 2-Way Pager
Model: 9200-2004

Test Report: J99026577_SAR
Date of Report: November 16, 1999

NVLAP Laboratory Code 200201-0
Accredited for testing to FCC Parts 15

Tested by:	Xi-Ming Yang	Xi-Ming Yang
Reviewed by:	Davic Chernomordik	David Chernomordik

Table of Contents

1 JOB DESCRIPTION

1.1 Client Information

The EUT has been tested at the request of

Company:	Glenayre Electronics Inc.
Address:	5935 Carnegie Boulevard Charlotte, North Carolina 28209
Name of contact:	Monika Lopez
Telephone:	(209) 955-5240
Fax:	(209) 642-6133

1.2 Equipment under test (EUT)

Product Descriptions:

Equipment	Two- Way Radio Pager		
Trade Name	AccessLink II	Model No.	9200-2004
FCC ID	K3N6000	S/N No.	RF2CR
Category	Portable	RF Exposure	Uncontrolled Environment
Frequency Band (uplink)	901 to 902 MHz	System	FSK

EUT Antenna Description			
Type	Monopole	Configuration	Internal, Fixed
Dimensions	37.5 (L) 7.8 (f) mm	Gain	0 dBi
Location	Inside plastic enclosure, left		

Use of Product :	Data communications
Manufacturer:	SAME as above.
Production is planned:	[X] Yes, [ ] No
EUT receive date:	11/11/99
EUT received condition:	Good working condition, prototype
Test start date:	11/11/99
Test end date:	11/11/99

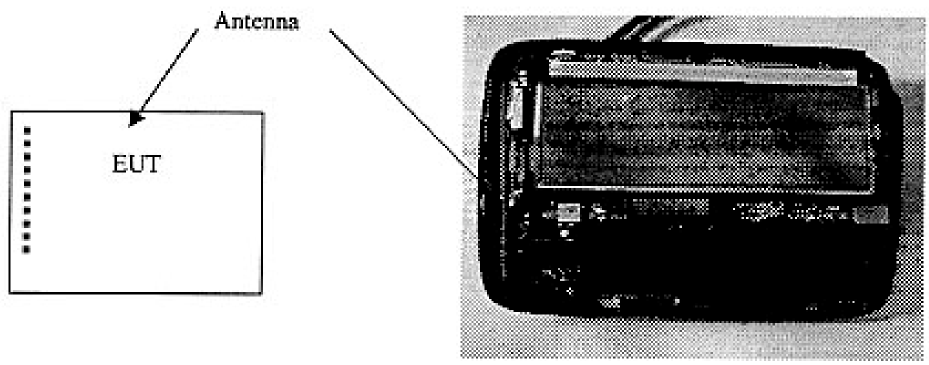
1.3 Test plan reference

FCC rule part 2.1093, FCC Docket 96-326 & Supplement C to OET Bulletin 65

1.4 System test configuration

1.4.1 System block diagram & Support equipment

The diagram shown below details test configuration of the equipment under test .



S:	Shielded	U:	Unshield	F:	With Ferrite Core

Support equipment					
Equp. #	Equipment	Manufacturer	Model #	S/N #	FCC ID
1					

1.4.2 Test Position

The EUT was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in C95.1 (1992) and Supplement C of OET 65 (1998). The EUT was placed in the intended use position, i.e. touching the human body or hand. Please refer to figure 1 below for the position details:

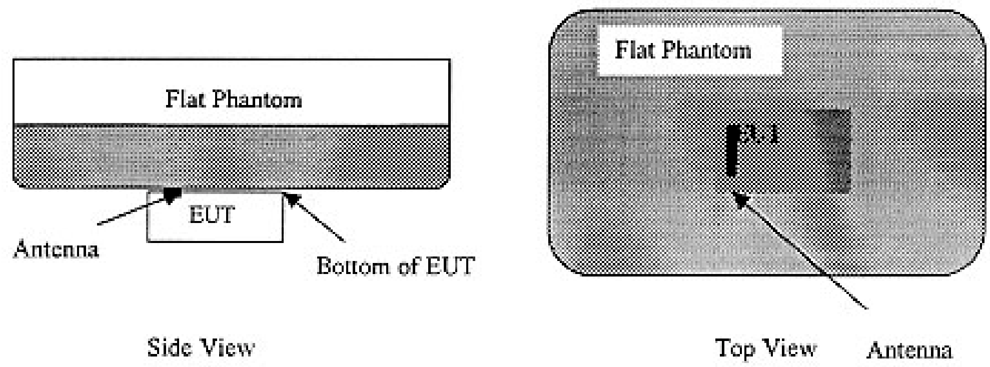


Figure 1: Intended use position

Figure 2 shows the location of antenna inside the EUT:

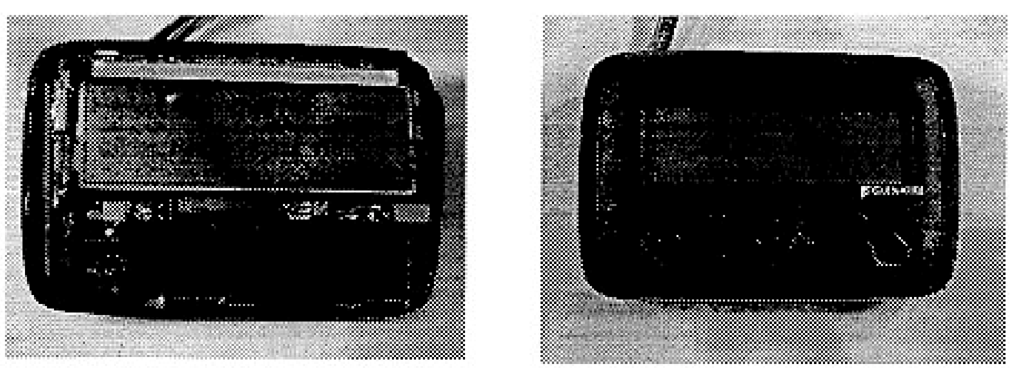


Figure 2: Antenna location

1.4.3 Test Condition

During tests, the worst case data (max. RF coupling) was determined with following conditions:

EUT Antenna	Fixed	Orientation	N/A
Usage	Body-worn and hand-held	Distance between base of EUT and the liquid surface:	2 mm
Simulating human hand	Not Used	EUT Battery	Fully Charged
Power output	1.0 W ERP (Maximum) 50% duty cycle (0.1 sec on and 0.1 sec off)		

The spatial peak SAR values were accessed for lowest and highest operating channels defined by the manufacturer. Tests were performed at test mode at 1.0 W ERP with 50% duty cycle (0.1 sec On and 0.1 sec 0ff) to reduce over heat the EUT. Care was taken to ensure that performance of the EUT power amplifier would not be degrade using CW test mode. A peak radiated field strength test was performed in both CW and pulse (50 % duty cycle) modes, and data show that peak power output in both operation modes were the same.

Radiated emission measurement was performed, before and after the SAR tests to ensure that the EUT operated at the highest power level.

1.5 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

1.6 Additions, deviations and exclusions from standards

No additions, deviations or exclusions have been made from standard.

2 SAR EVALUATION

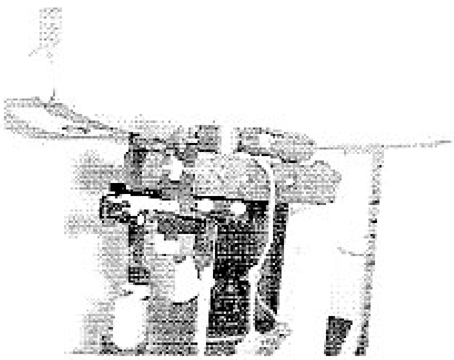
2.1 SAR Limits

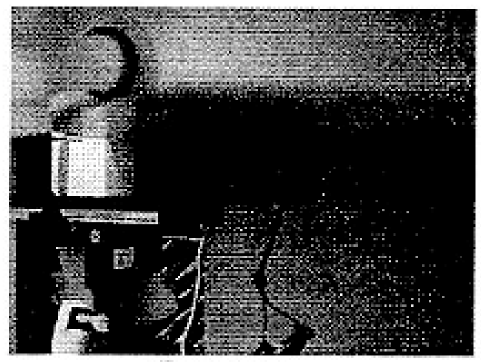
The following FCC limits for SAR apply to devices operate in General Population/Uncontrolled Exposure environment:

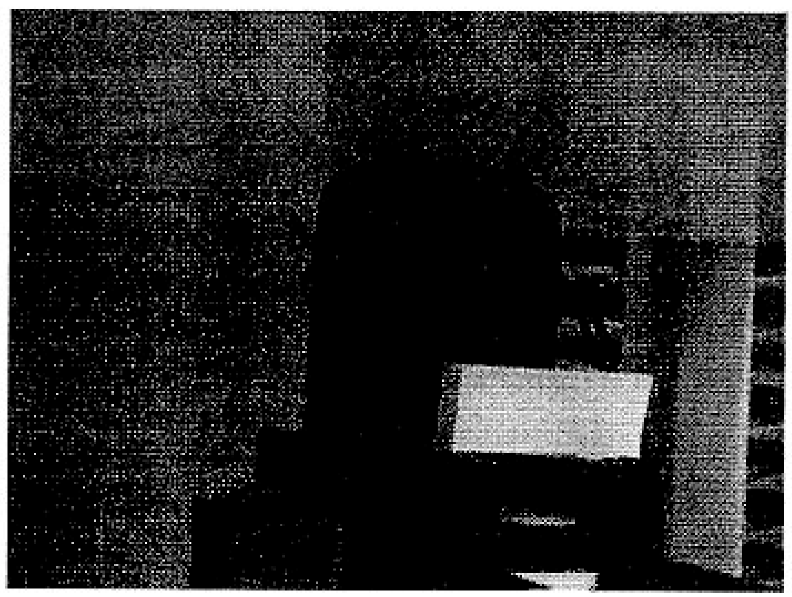
EXPOSURE (General Population/Uncontrolled Exposure environment)	SAR (W/kg)
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

2.2 Configuration Photographs

Worst-Case SAR measurement
at


Face Up


Face down


Vertical

2.3 System Verification

Prior to the assessment, the system was verified to the ±5% of the specifications by using the system validation kit. The validation was performed at 900 MHz.

Validation kit	Targeted SAR_{1g} (mW/g)	Measured SAR_{1g} (mW/g)
D900V2, S/N #: 013	4.03	3.97

2.4 Evaluation Procedures

The SAR evaluation was performed with the following procedures:

a. SAR was measured at a fixed location above the reference point and used as a reference value for the assessing the power drop.

b. The SAR distribution at the exposed side of the flat phantom was measured at a distance of 2.0 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20 mm x 20 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.

c. Around this point, a volume of 32 mm x 32 mm x 34 mm was assessed by measuring 5 x 5 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

    I) The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measurement point is 1.6 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in Z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

    ii) The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3-D spline interpolation algorithm. The 3-D spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y and z directions). The volume was integrated with the trapezoidal algorithm. 1000 points (10 x 10 x 10) were interpolated to calculate the average.

    iii) All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

d. Re-measurement of the SAR value at the same location as in step a. above. If the value changed by more than 5 %, the evaluation was repeated.

2.5 Test Results

The results on the following page(s) were obtained when the device was tested in the condition described in this report. Detail measurement data and plots which reveal information about the location of the maximum SAR with respect to the device, are reported in Appendix A.

The maximum spatial peak SAR values average over 1g assessed in "touch" position was 3.27 mW/g for the tested unit when tested in test mode. In actual usage, the average transmission is only 8.53% (please refer to the manufacturer justification in section 8 of this report). In considering the 8.53% duty cycle to the measured SAR data, the unit is in compliance with the requirements of the FCC for body requirements.

The maximum spatial peak SAR values average over 10g assessed in "touch" position was 2.11 mW/g for the tested unit when tested in test mode. The unit is in compliance with the requirements of the FCC for hands and feet requirements.

Trade Name:	AccessLink I II	Model No.:	9200-2004
Serial No.:	RF2CR	Test Engineer:	XM Yang

TEST CONDITIONS			
Ambient Temperature	23.8 °C	Relative Humidity	48 %
Test Signal Source	Test Mode	Signal Modulation	50%
Output Power Before SAR Test	1.0 W	Output Power After SAR Test	1.0 W
Test Duration	18 Min.	Number of Battery Change	DC power supply

Usage (Touch position)					
Plot #	Position	Frequency	Measured ERP Power (W)	Measured SAR_{1g} (mW/g)	Measured SAR_{10g} (mW/g)
1	Vertical	901	1.0	0.994	0.503
2	Face Up	901	1.0	2.80	2.01
3	Face down	902	1.0	3.27	2.11
4	Face down	901	1.0	3.16	2.01

Note: a) Worst case data were reported
b) Duty cycle factor included in the measured SAR data
c) Uncertainty of the system is not included
d) Transmission duty cycle not included.

SAR results with Duty Cycle		
Plot #	Measured SAR_{1g} (mW/g)	SAR_{1g} with 8.53% duty cycle + 50% test mode (mW/g)
1	0.994	0.17
2	2.80	0.48
3	3.27	0.56
4	3.16	0.54

3 TEST EQUIPMENT

3.1 Equipment List

The Specific Absorption Rate (SAR) tests were performed with the SPEAG model DASY 3 automated near-field scanning system which is package optimized for dosimetric evaluation of mobile radios [3]. The following major equipment/components were used for the SAR evaluations:

SAR Measurement System			
EQUIPMENT	SPECIFICATIONS	S/N #	CAL. DATE
Robot	**Stäubi RX60L**	597412-01	N/A
	Repeatability: ± 0.025mm Accuracy: 0.806×10^{-3} degree Number of Axes: 6		
E-Field Probe	**ET3DV5**	1333	03/18/99
	Frequency Range: 10 MHZ to 6 GHz Linearity: ± 0.2 dB Directivity: ± 0.1 dB in brain tissue		
Data Acquisition	**DAE3**	317	N/A
	Measurement Range: 1μV to >200mV Input offset Voltage: < 1μV (with auto zero) Input Resistance: 200 M		
Phantom	**Generic Twin V3.0**	N/A	N/A
	Type: Generic Twin, Homogenous Shell Material: Fiberglass Thickness: 2 ± 0.1 mm Capacity: 20 liter Ear spacer: 4 mm (between EUT ear piece and tissue simulating liquid)		
Simulated Tissue	**Mixture**	N/A	04/12/99
	Please see section 3.2 for details		
Power Meter	HP 435A w/ 8481H sensor	1312A01255	02/1/99
	Frequency Range: 100kHz to 18 GHz Power Range: 300μW to 3W		

3.2 Muscle Tissue Simulating Liquid

Ingredient	Frequency (800 - 850 MHz)
Water	54.05 %
Sugar	45.05 %
Salt	0.1 %
Bactericide	0.8 %

The dielectric parameters were verified prior to assessment using the HP 85070A dielectric probe kit and the HP 8753C network Analyzer. The dielectric parameters were:

Frequency (MHZ)	ε*	σ*(mho/m)	ρ**(kg/m^3)
815	56.5 ± 5%	0.94 ± 10%	1000

* *worst case uncertainty of the HP 85070A dielectric probe kit*

** worst case assumption

3.3 E-Field Probe Calibration

Probes were calibrated by the manufacturer in the TEM cell ifi 110. To ensure consistency, a strict protocol was followed. The conversion factor (ConF) between this calibration and the measurement in the tissue simulation solution was performed by comparison with temperature measurement and computer simulations. Probe calibration factors are included in Appendix C.

3.4 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the NIS81 [5] and the NIST 1297 [6] documents and is given in the following table. The extended uncertainty (K=2) was assessed to be 23.5 %

UNCERTAINTY BUDGET				
Uncertainty Description	Error	**Distrib.**	**Weight**	**Std.Dev.**
Probe Uncertainty				
Axial isotropy	±0.2 dB	U-shape	0.5	±2.4 %
Spherical isotropy	±0.4 dB	U-shape	0.5	±4.8 %
Isotropy from gradient	±0.5 dB	U-shape	0	
Spatial resolution	±0.5 %	Normal	1	±0.5 %
Linearity error	±0.2 dB	Rectang.	1	±2.7 %
Calibration error	±3.3 %	Normal	1	±3.3 %
SAR Evaluation Uncertainty				
Data acquisition error	±1 %	Rectang.	1	±0.6 %
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %
Conductivity assessment	±10 %	Rectang.	1	±5.8 %
Spatial Peak SAR Evaluation Uncertainty				
Extrapol boundary effect	±3 %	Normal	1	±3 %
Probe positioning error	±0.1 mm	Normal	1	±1 %
Integrat. And cube orient	±3 %	Normal	1	±3 %
Cube shape inaccuracies	±2 %	Rectang.	1	±1.2 %
Device positioning	±6 %	Normal	1	±6 %
Combined Uncertainties				**±11.7 %**

3.5 Measurement Tractability

All measurements described in this report are traceable to National Institute of Standards and Technology (NIST) standards or appropriate national standards.

4 WARNING LABEL INFORMATION - USA

Not applicable.

5 REFERENCES

[1] ANSI, *ANSI/IEEE C95.1-1991: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 Ghz*, The Institute of electrical and Electronics Engineers, Inc., New York, NY 10017, 1992

[2] Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C. 20554, 1997

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", *IEEE Transaction on Microwave Theory and Techniques*, vol. 44, pp. 105-113, Jan. 1996.

[4] Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetic evaluation of mobile communications equipment with know precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp.645-652, May 1997.

[5] NIS81, NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddinton, Middlesex, England, 1994.

[6] Barry N. Tayor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994.

6 APPENDIX A - SAR EVALUATION DATA

Please note that the graphical visualization of the phone position onto the SAR distribution gives only limited information on the current distribution of the device, since the curvature of the head results in graphical distortion. Full information can only be obtained either by H-field scans in free space or SAR evaluation with a flat phantom.

Powerdrift is the measurement of power drift of the device over one complete SAR scan.

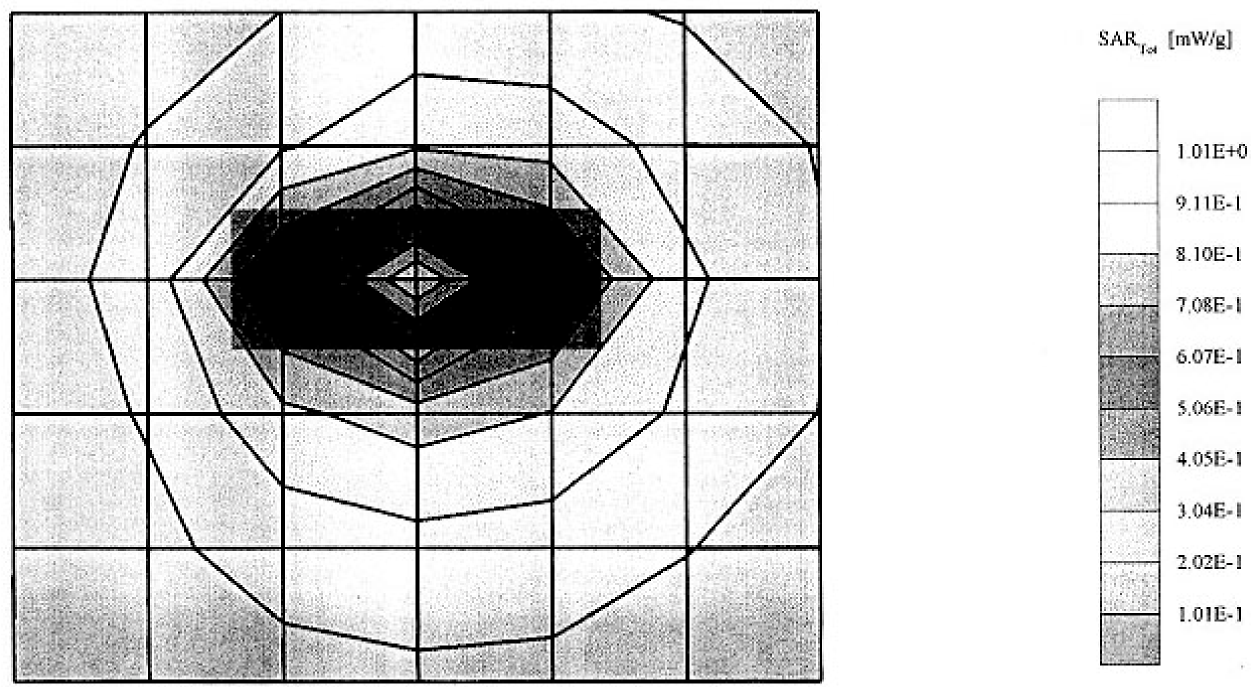
6.1 Plots

11/11/99

Plot 1

Two-way Radio Pager

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 901 MHz
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest factor: 1.0; Muscle 900 MHz: σ = 0.99 mho/m ε_r = 55.7 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.994 mW/g, SAR (10g): 0.503 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.07 dB
Vertical Position

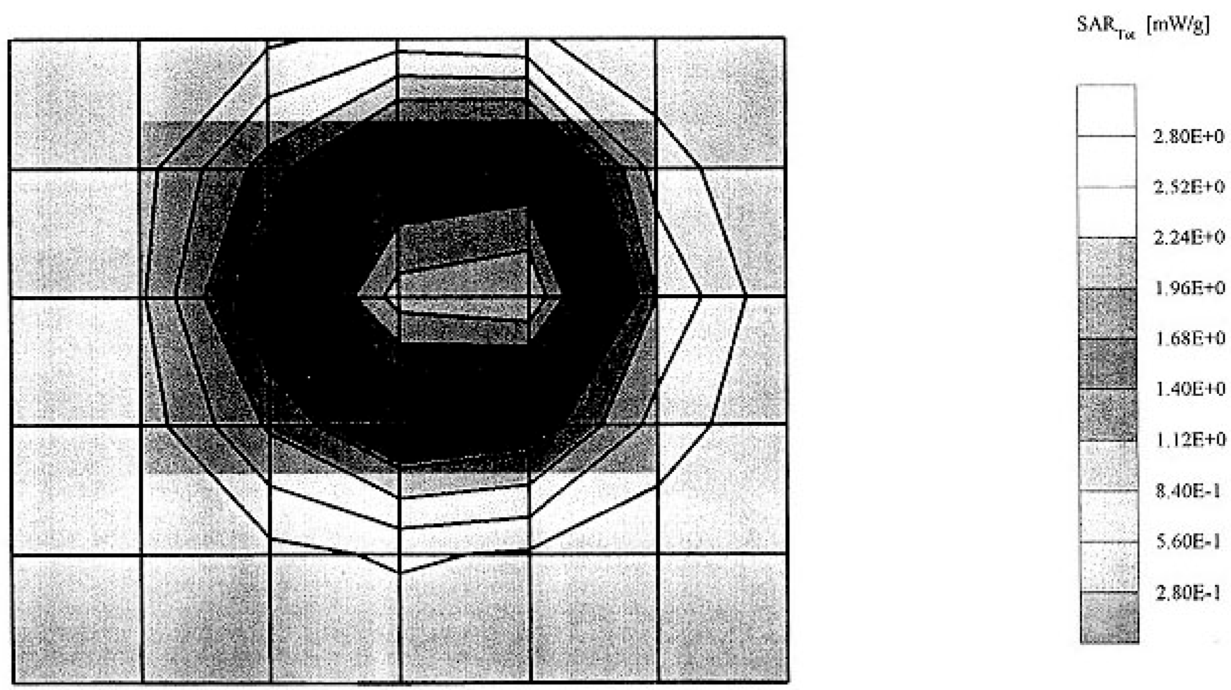


11/11/99

Plot 2

Two-way Radio Pager

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 901 MHz
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 55.7$ $\rho = 1.00$ g/cm^3
Cube 5x5x7: SAR (1g): 2.80 mW/g, SAR (10g): 2.01 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.13 dB
Face Up

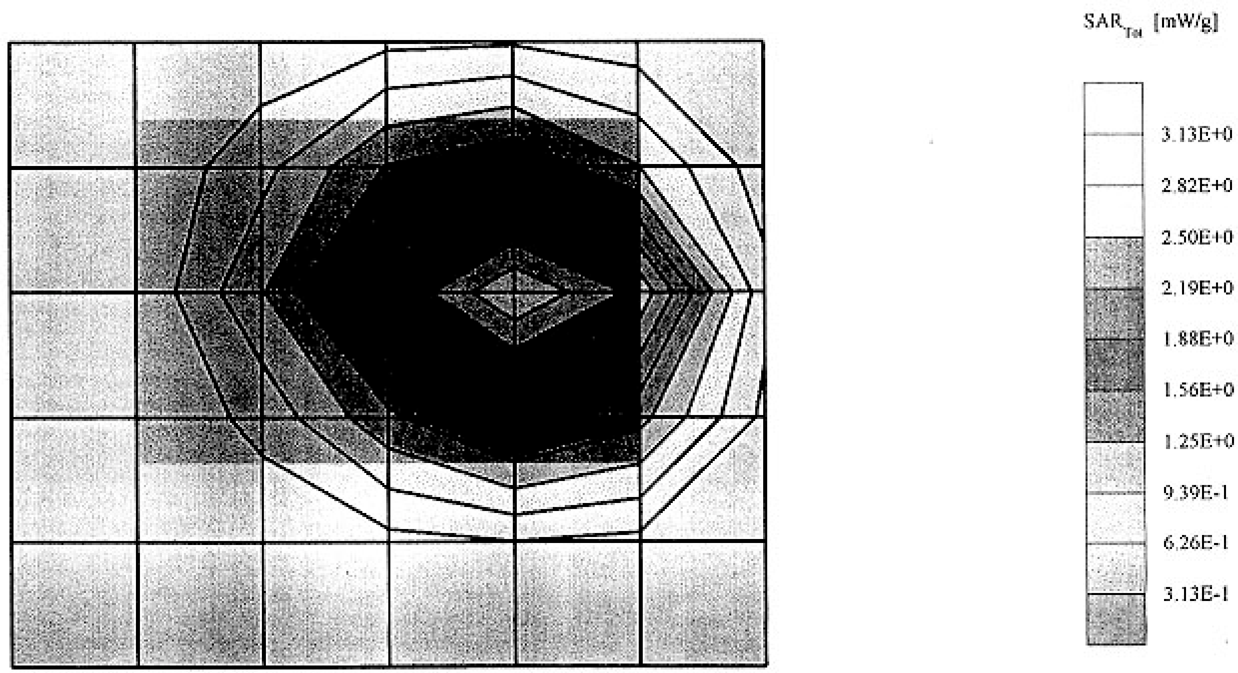


11/11/99

Plot 3

Two-way Radio Pager

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 902 MHz
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest factor: 1.0; Muscle 900 MHz: σ = 0.99 mho/m ε_r = 55.7 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 3.27 mW/g, SAR (10g): 2.11 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.10 dB
Face Down

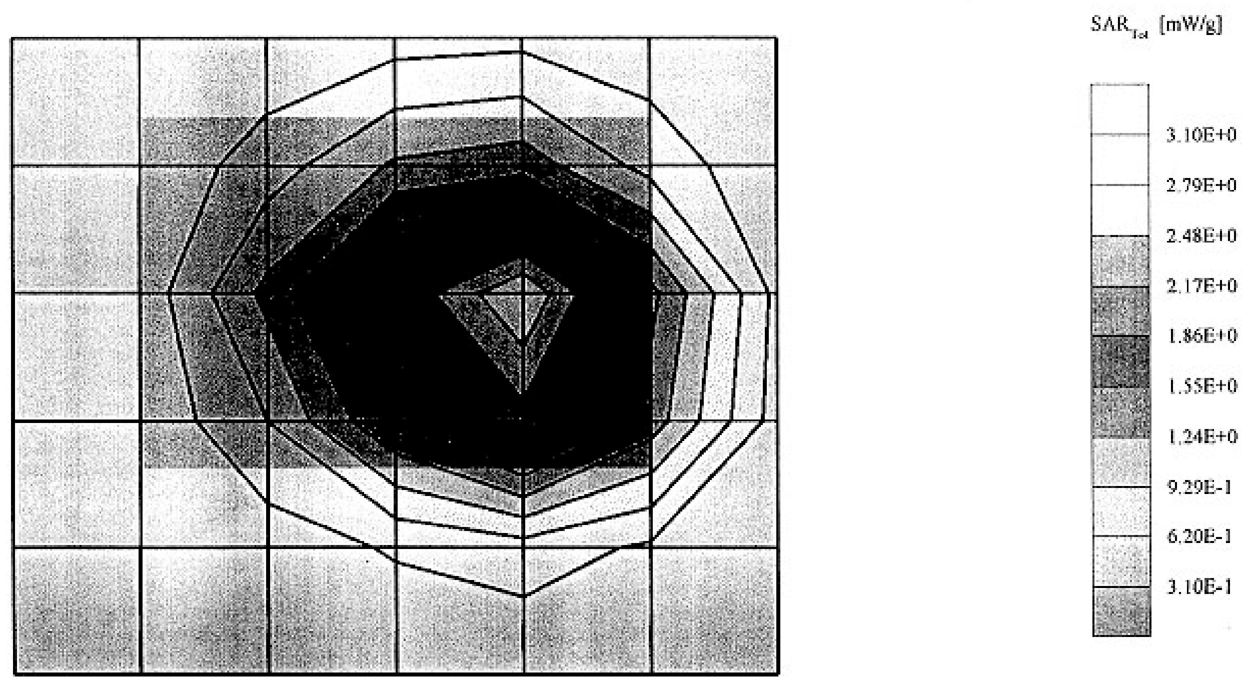


11/11/99

Plot 5

Two-way Radio Pager

Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 901 MHz
Probe: ET3DV5 - SN1333; ConvF(5.85,5.85,5.85); Crest factor: 1.0; Muscle 900 MHz: $\sigma = 0.99$ mho/m $\varepsilon_r = 55.7$ $\rho = 1.00$ g/cm³
Cube 5x5x7: SAR (1g): 3.16 mW/g, SAR (10g): 2.01 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.26 dB
Face Down



7 APPENDIX B - E-FIELD PROBE CALIBRATION DATA

[X] See Separate Attachment
[ ] See Below

Schmid & Partner
Engineering AG

Staffelstrasse 8, 8045 Zurich, Switzerland, Telefon +41 1 280 05 60, Fax +41 1 280 08 64

Probe ET3DV5

SN:1333

Manufactured:	December 1997
Calibrated:	January 1998
Recalibrated:	March 1999

Calibrated for System DASY3

Introduction

The performance of all probes is measured before delivery. This includes an assessment of the characteristic parameters, receiving patterns as a function of frequency, frequency response and relative accuracy. Furthermore, each probe is tested in use according to a dosimetric assessment protocol. The sensitivity parameters (NormX, NormY, NormZ), the diode compresion parameter (DCP) and the conversion factor (ConvF) of the probe and some of the measurement diagrams are given in the following.

The performance of the individual probes varies slightly due to tolerances arising from the manufacturing process. Since the lines are highly resistive (several MOhms), the offset and noise problem is greatly increased if signals in the low μV range are measured. Accurate measurement below 10 μW/g are possible if the following precautions are taken. 1) check the current grounding with the *multimeter*[1], i.e., low noise levels, 2) compensate the current *offset*[1], 3) use long integration time (approx. 10 seconds), 4) *calibrate*[1] before each measurement, 5) persons should avoid moving around the lab while measuring.

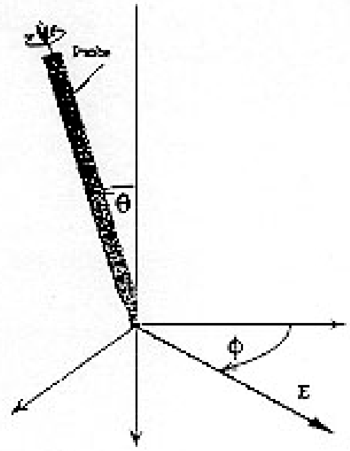


Fig 1: Due to the field distortion caused by the supporting material, the probe has two characteristic directions, referred to as angle ψ and θ.

Since the field distortion caused by the supporting material and the sheath is quite high in the θ direction, the receiving pattern is poor in air. However, the distortion in tissue equivalent material is much less because of its high dielectricity. In addition, the fields induced in the phantoms by dipole structures close to the body are dominently parallel to the surface. Thus, the error due to non-isotropy is much better than 1 dB for dosimetric assessments.

The probes are calibrated in the TEM cell ifi 110 although the field distribution in the cell is not very uniform and the frequency response is not very flat. To ensure consistency, a strict protocol is followed. The conversion factor (ConF) between this calibration and the measurement in the tissue simulation solution is performed by comparison with temperature measurements and computer simulations. This conversion factor is only valid for the specified tissue simulating liquids at the specified frequencies. If measurements have to be performed in solutions with other electrical properties or at other frequencies, the conversion factor has to be assessed by the same procedure.

As the probes have been constructed with printed resistive lines on ceramic substrates (thick film technique), the probe is very delicate with respect to mechanical shocks.

Attention:

Do not drop the probe or let the probe collide with any solid object. Never let the robot move without first activating the emergency stop feature (i.e., without first turning the data acquisition electronics on).

[1] Feature of the DASY Software Tool.

DASY3 - Parameters of Probe: ET3DV5 SN:1333

Sensitivity in Free Space

NormX	**2.34**	$\mu V/(V/m)^2$
NormY	**2.3**	$\mu V/(V/m)^2$
NormZ	**2.3**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**100**	mV
DCP Y	**100**	mV
DCP Z	**100**	mV

Sensitivity in Tissue Simulating Liquid

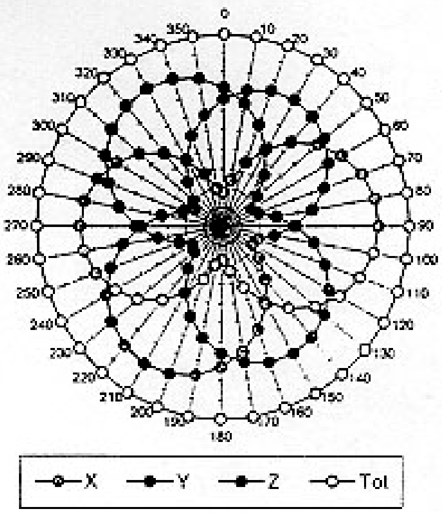
450 MHz	ConvF X	**6.38**	extrapolated	ε_r =	48 ± 5%
	ConvF Y	**6.38**	extrapolated	σ =	0.50 ± 10% mho/m
	ConvF Z	**6.38**	extrapolated	(brain tissue simulating liquid)	
900 MHz	ConvF X	**6.03**	± 10%	ε_r =	42.5 ± 5%
	ConvF Y	**6.03**	± 10%	σ =	0.86 ± 10% mho/m
	ConvF Z	**6.03**	± 10%	(brain tissue simulating liquid)	
1500 MHz	ConvF X	**5.55**	interpolated	ε_r =	41 ± 5%
	ConvF Y	**5.55**	interpolated	σ =	1.32 ± 10% mho/m
	ConvF Z	**5.55**	interpolated	(brain tissue simulating liquid)	
1800 MHz	ConvF X	**5.31**	± 10%	ε_r =	41 ± 5%
	ConvF Y	**5.31**	± 10%	σ =	1.69 ± 10% mho/m
	ConvF Z	**5.31**	± 10%	(brain tissue simulating liquid)	

Sensor Offset

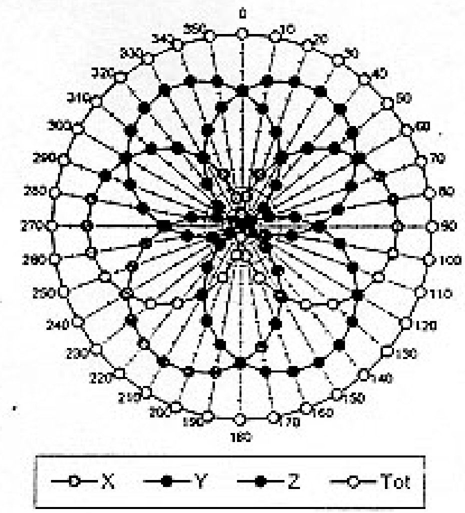
Probe Tip to Sensor Center	**2.7**	mm
Surface to Probe Tip	**1.7 ± 0.2**	mm

Receiving Pattern (ϕ), θ = 0°

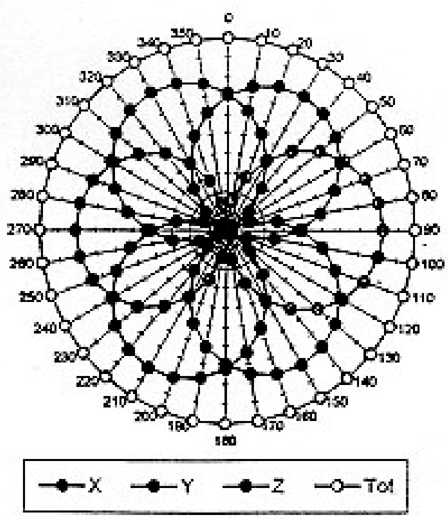
f = 30 MHz, TEM cell ifi110



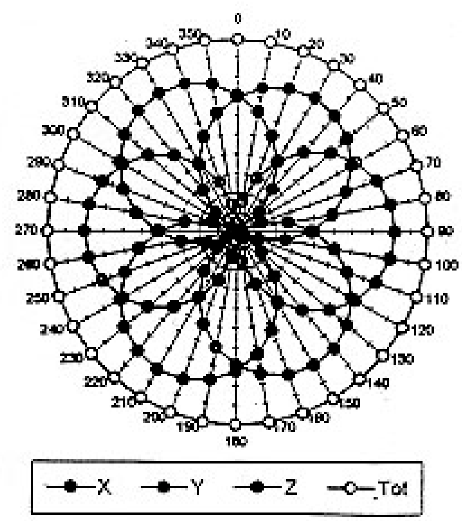
f = 100 MHz, TEM cell ifi110



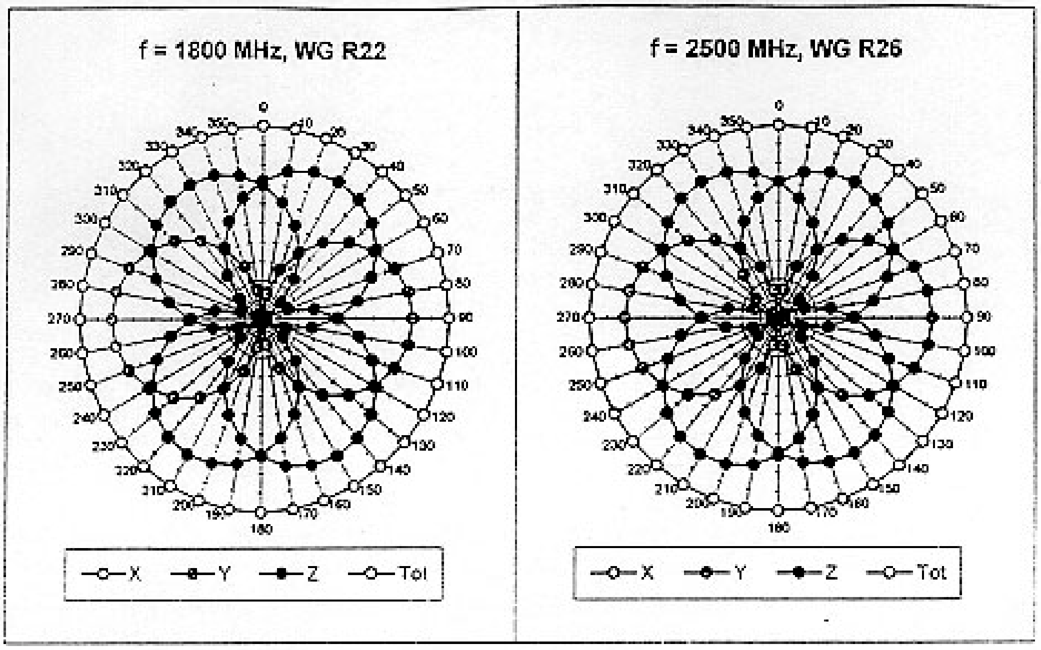
f = 300 MHz, TEM cell ifi110



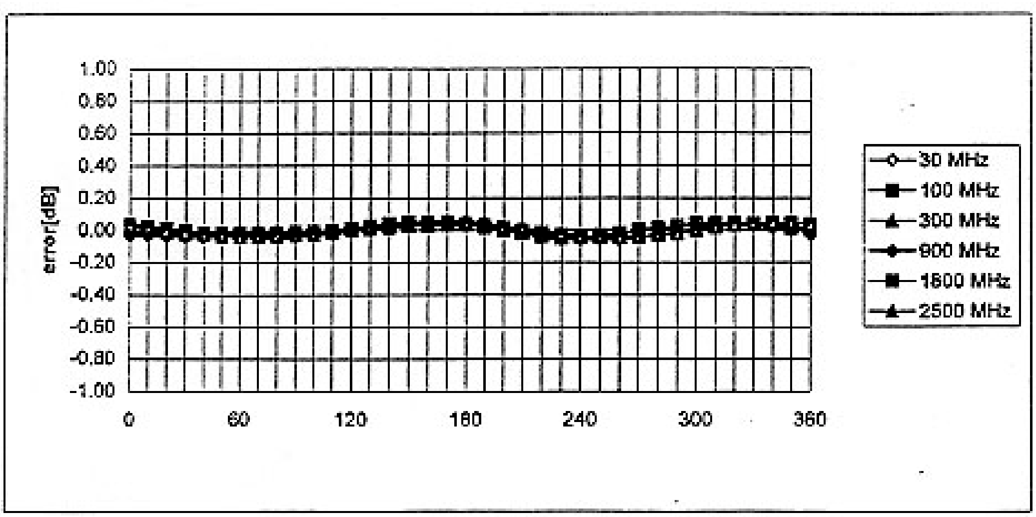
f = 900 MHz, TEM cell ifi110



ET3DV5 SN:1333

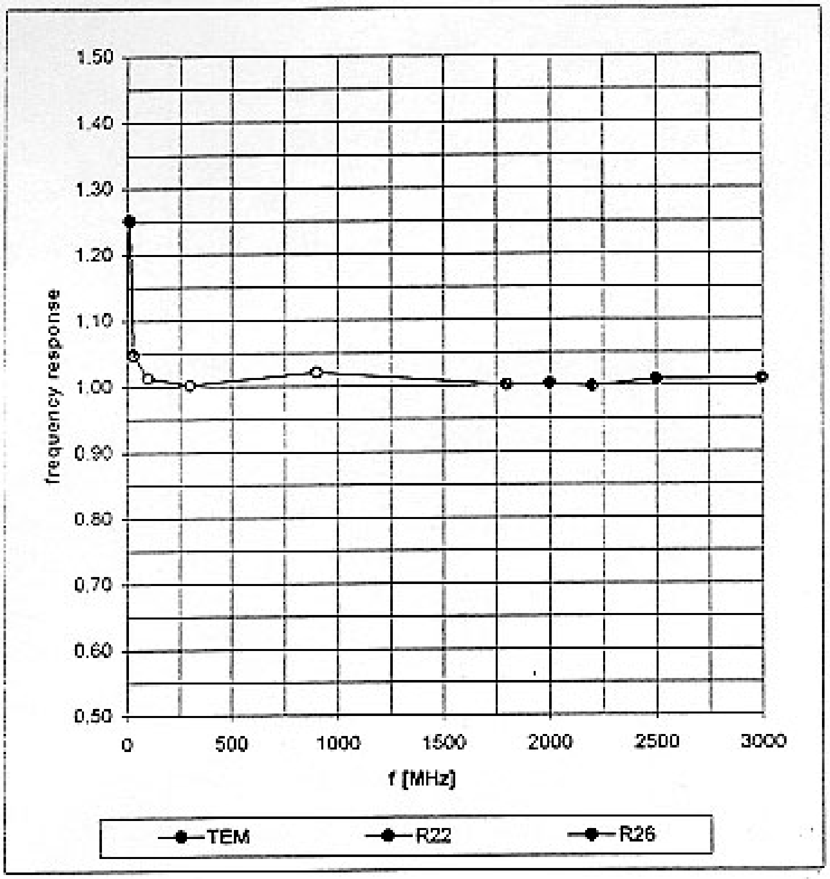


Isotropy Error (φ), θ = 0°



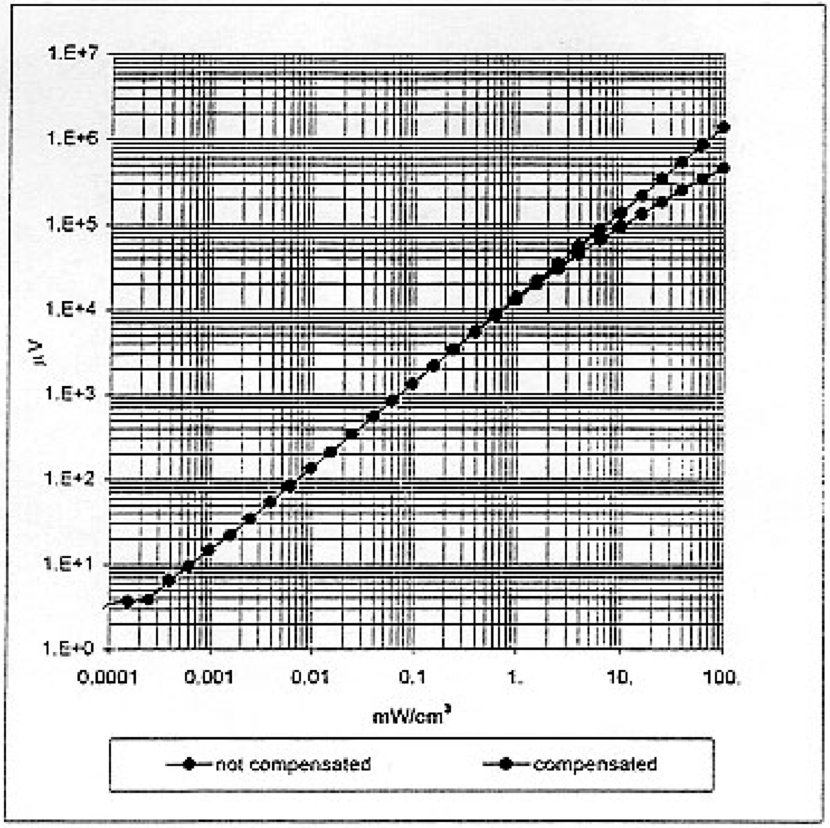
Frequency Response of E-Field

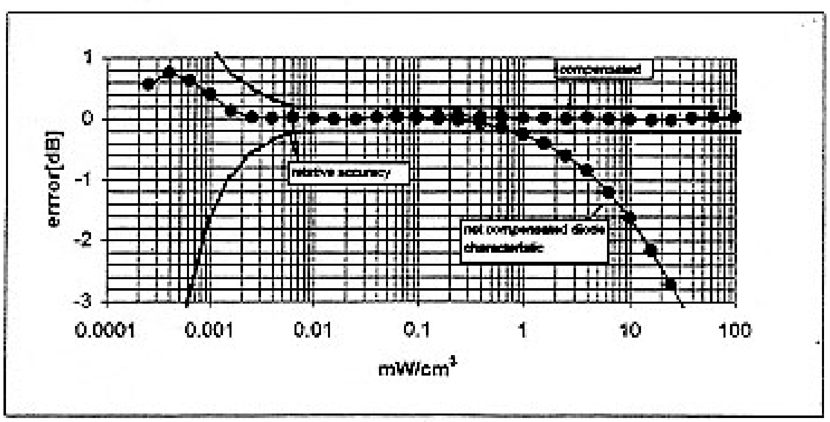
(TEM-Cell:ifi110, Waveguide R22, R26)



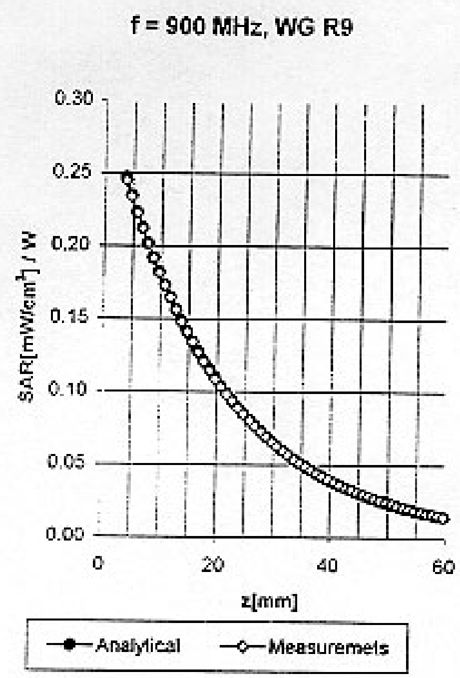
Dynamic Range f(SAR_{brain})

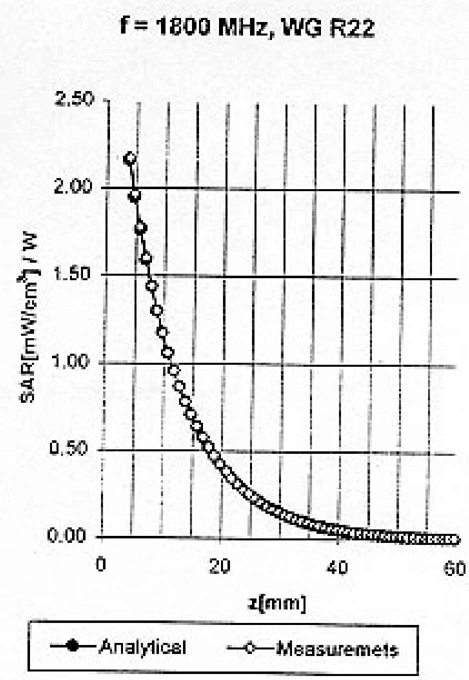
(TEM-Cell:ifi110)





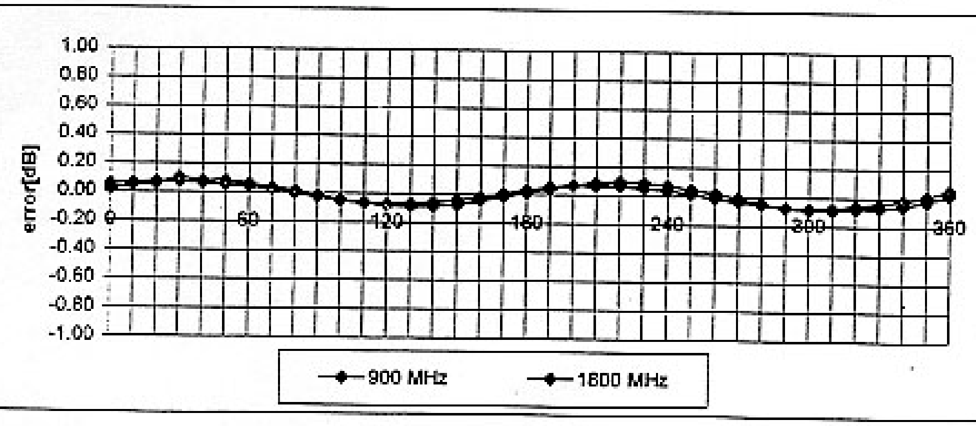
Conversion Factor Assessment





Receiving Pattern (ϕ)

(in brain tissue, z = 5 mm)



8 APPENDIX C - TECHNICAL JUSTIFICATION FROM MANUFACTURER

[X] See separate attachment

GLENAYRE

Wireless Access Group
2101 Tasman Drive
Santa Clara, CA 95054 USA
tel 408-653-1555
fax 408-567-1069

Description of the Duty Cycle for the AccessLinkII 2-way pager

The duty cycle of the AccessLinkII is based on the protocol. The frame time is 1.875 sec as defined by the protocol. At the slowest transmit data rate defined by the protocol (800bps), the transmit pulse duration is 160msec. Therefore, the maximum duty cycle is 0.0853. The 160 msec transmit pulse duration is the duration of an acknowledgement pulse when a message is received. In order to obtain the maximum duty cycle, a message would have to be received in every frame. For this to happen, messages would have to be sent continuously to the device, the network would have to have little traffic, and the device would have to be operated at its minimum duty cycle. The protocol allows the duty cycle to be adjusted and today is run at 8 times this minimum meaning that the actual maximum duty cycle in operation today is actually 1/8 of the value given above. Given the probability of all of these incidences occurring at the same time, it is nearly impossible that this maximum duty cycle would ever be achieved in practice.

GLENAYRE™

Wireless Access Group
2101 Tasman Drive
Santa Clara, CA 95054 USA
tel 408-653-1555
fax 408-567-1069

Description of the AccessLinkII Antenna

The AccessLinkII 2-way pager has an internal antenna only. There is no external antenna, nor any external cable for an external antenna connection. The internal antenna is an unequal current density fed dipole with perpendicular ground plane. The dipole is etched into a PC board assembly attached perpendicular to the RF PCB assembly located parallel to the left edge of the pager and positioned a few millimeters inside the plastic. The antenna ground is the electrical ground of the RF Printed Circuit Board. There are no requirements for the pager to have an external ground attached to it for its antenna to operate. The AccessLinkII has been designed to be a free standing, self-contained device which functions independently without external connections.